OIF Reachback Architecture

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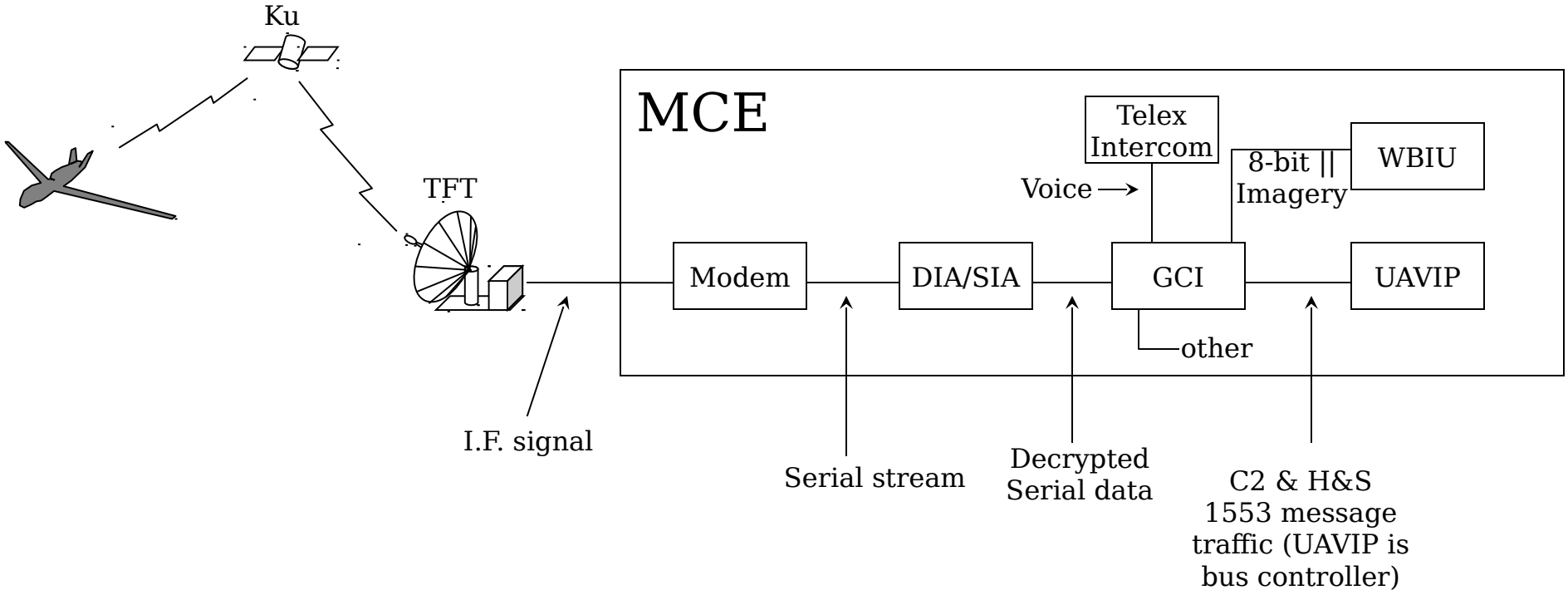
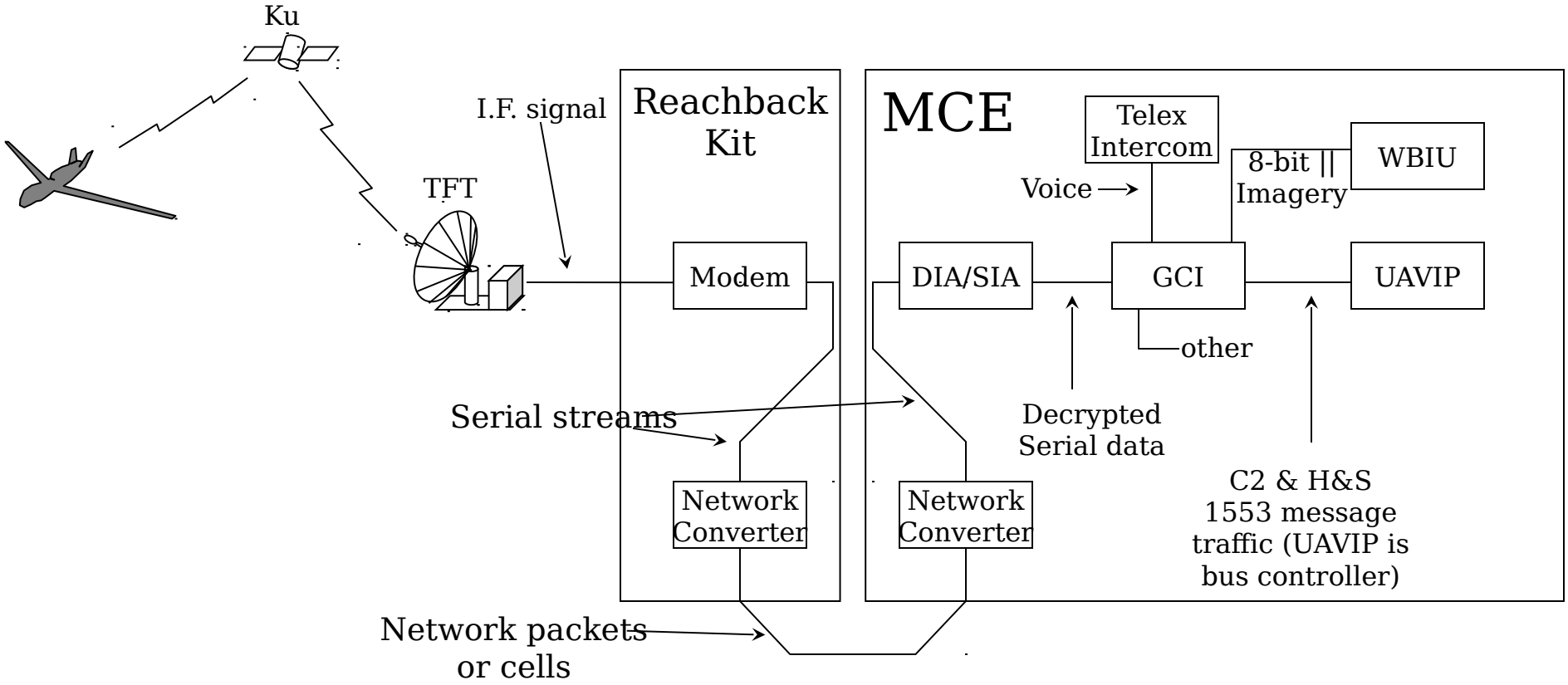
Baseline Architecture



The MCE typically communicates with the Air Vehicle via Ku Satcom. Data from a COTS modem is sent via serial stream to the Satellite Interface Assembly (SIA), where it is decrypted, and sent to the GCI, where C2 and Imagery, etc. are split out.

Reachback Modification

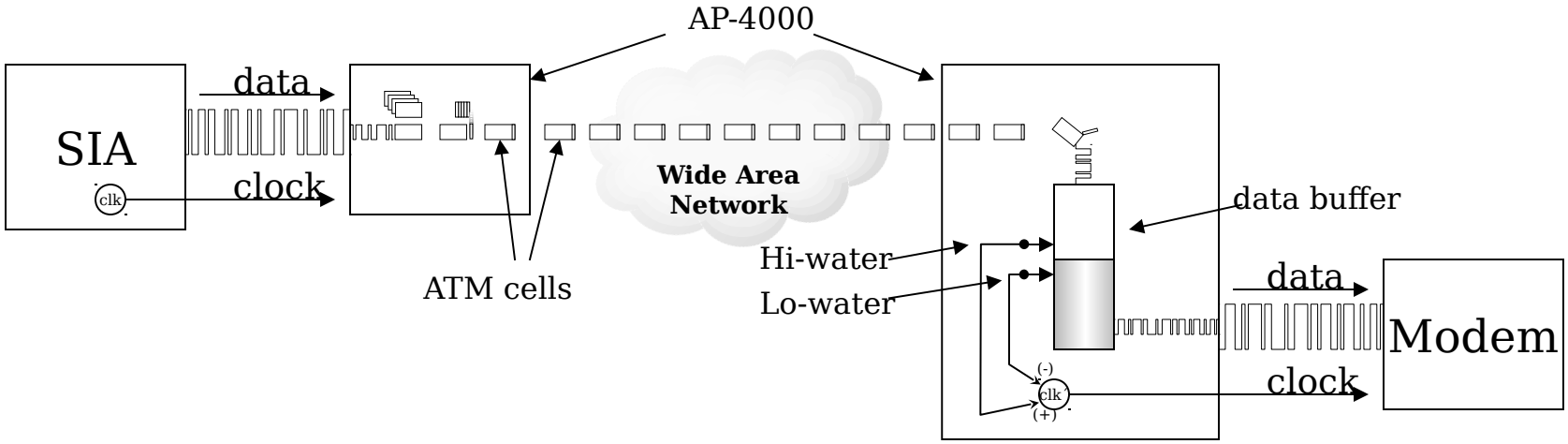


Reachback interrupts the serial streams between modems and DIA/SIA and packetizes the data so it can be forwarded over a long-haul network.

Metrodata AP-4000

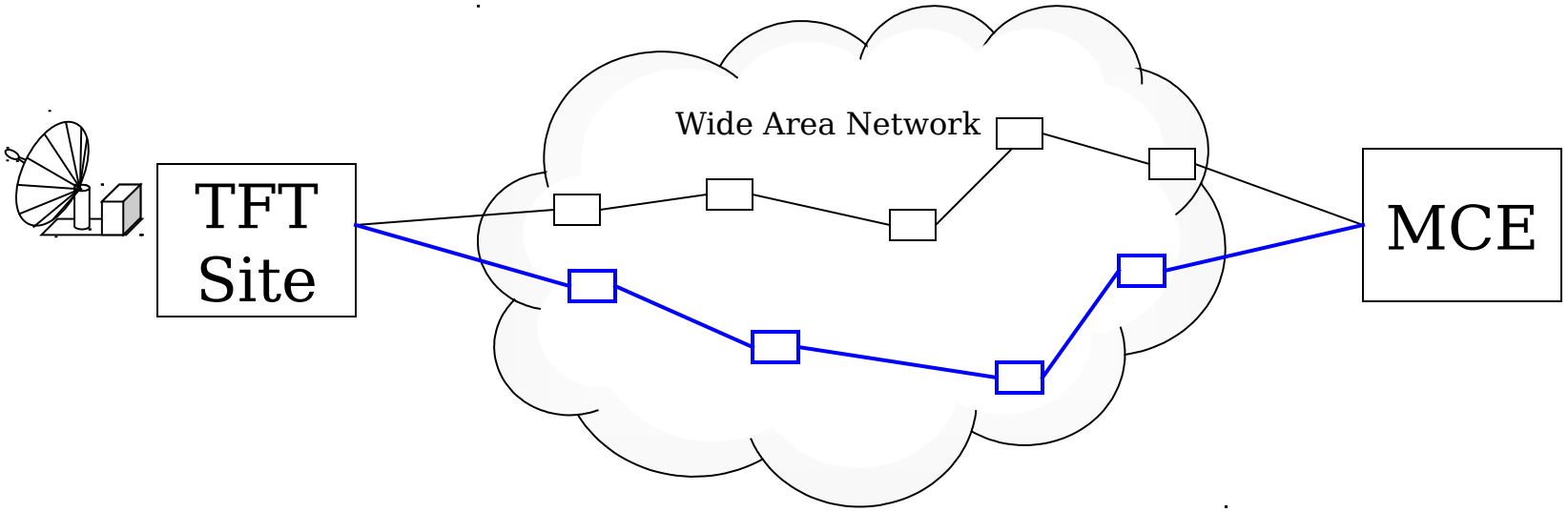
- Metrodata AP-4000 was chosen to provide serial stream to ATM cell conversion.
- 4-slot chassis with dual redundant power supplies and a single processor. Capable of hosting an ATM network module and up to three serial interfaces.
- HSSI ECL module and an EIA-530 module interface with the SDM-9000 and SLM-8650 modems, respectively.
- Frequency can be adjusted in 1Hz increments, and adaptive timing provides frequency stability better than 100ppm (.01%).

Clock Synchronization



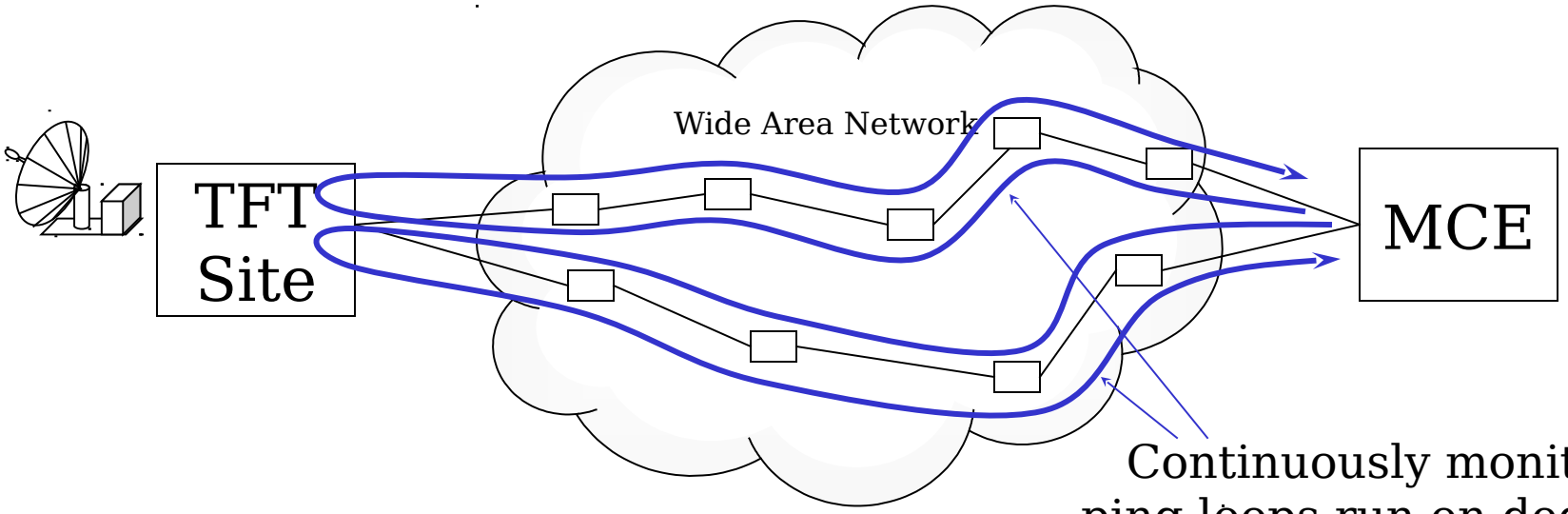
Adaptive timing varies the output clock rate based on the data level in a buffer. As the level drops, clock rate is decreased; as it rises, clock rate is increased. This provides an average output clock rate identical to the input clock rate.

Redundancy



Two physically separate, redundant PVPs are required to minimize risk of network loss. Failover from Primary to Backup is accomplished through a manual fiber patch in the MCE.

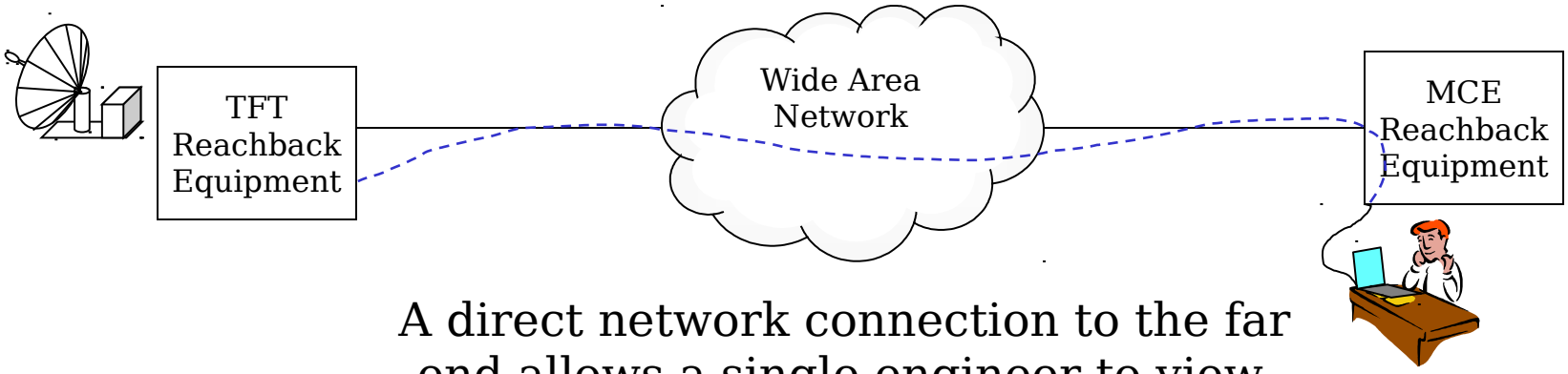
Circuit Monitoring



Continuously monitored ping loops run on dedicated 18kbps Permanent Virtual Channels (PVCs) within the two PVPs.

For continuous monitoring, periodic ICMP (ping) packets are looped through each of the PVP’s, allowing the MCE operators to easily monitor and track availability of both paths.

Remote Control and Configuration



A direct network connection to the far end allows a single engineer to view, configure and troubleshoot both ends of the Reachback circuit

Dedicated 512kbps channels within the PVPs are established for direct TCP/IP connections between the black switches. These connections allow MCE engineers to log in to the TFT Reachback equipment and make configuration changes remotely.

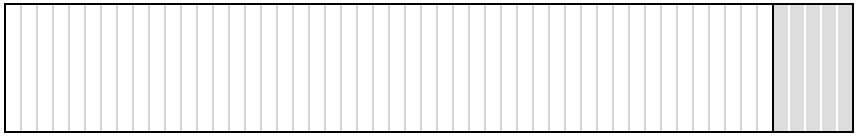
Overheads

Forward Error Correction

208 bits of FEC'd data for every
192 bits of user data (+ 8.33% OH)

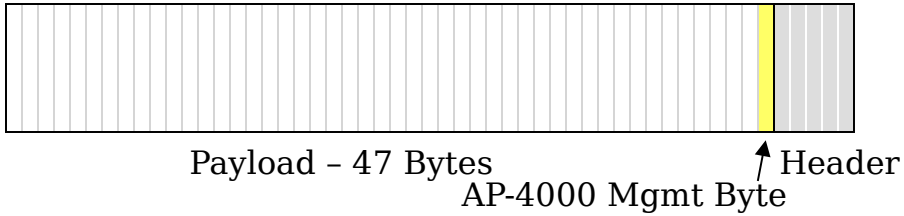
ATM Cell overhead

5 bytes of header data in each
53 byte cell (+ 10.4% OH)



AP-4000 overhead

1 bytes of management data in each
53 byte cell (+ 2.1% OH)



Total Overhead – user data to ATM circuit: 22.2

Excessive Link Delay

- AICS and GICS communicate with a sliding window protocol (SWP) designed to provide error free, reliable transmission of certain C2 and H&S messages.
- SWP uses acknowledgment time-outs to trigger retransmission of messages.
- Excessive Link Delay could cause unnecessary retransmits and use up C2 path bandwidth.

Excessive Link Delay (cont.)

But…

- SWP is designed to gracefully handle retransmitted messages transparently.
- AICS and GICS have 100kbps dedicated to C2/H&S, while IMMC can only support 25kbps.
- C2 and H&S require only a few kbps under worst conditions, unless TDS system is installed, or mission plan upload is required, or ACG/ACM message traffic is high.
- Retransmit timeout is set to 1 second.

Excessive Link Delay (cont.)

So…

- Link delays resulting in up to four duplicate transmissions (i.e., up to four seconds) are transparent to the end users.
- Link delays greater than four seconds, but less than 20 seconds will not significantly impact* normal C2, but may slow down ACG/ACM message traffic, mission plan loads, and TDS messages.
- Link Delays greater than 20s may significantly affect C2 and H&S traffic.

**Aside from the immediate effect of the delay on C2 responsiveness.*

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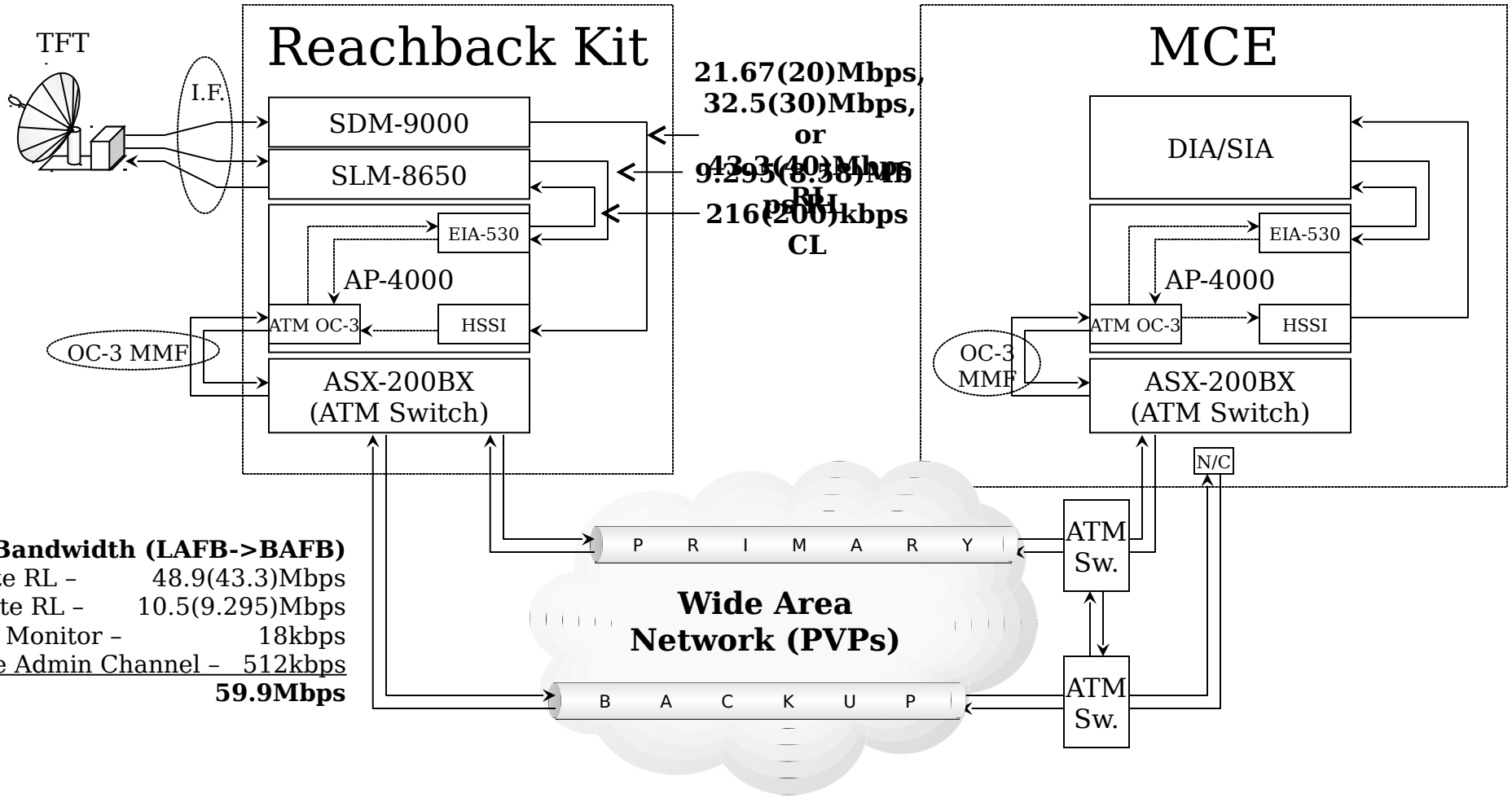

Bandwidth (LAFB->BAFB)

ate RL –	48.9(43.3)Mbps
Rate RL –	10.5(9.295)Mbps
it Monitor –	18kbps
te Admin Channel –	512kbps
	59.9Mbps